REMARKS

In view of the above amendments and the following remarks, reconsideration and further examination are respectfully requested.

Status of All of the Claims

Below is the status of the claims in this application.

1. Claim(s) pending: 1-10.
2. Claim(s) canceled: 11.
3. Claim(s) added: none.
4. Claims withdrawn from consideration but not canceled: none.

It is believed that the above-identified amended claims are supported by the application as originally filed. For example, support for amended claims 6 and 10 can be found at least at paragraphs [15] and [17] of the publication. As an initial matter, claim 5 has been amended to correct a minor typographical error.

Brief Summary of the Present Disclosure

Before addressing the rejections under §103(a) and §112, a brief summary of the present disclosure will be presented. The disclosure relates to monitoring the corrosion of a working electrode for purposes of estimating the type and severity of corrosion of an associated structure, such as a metal pipe. Both impedance and noise are of interest in assessing corrosion. Prior art systems have required <u>two working electrodes</u>, in addition to a reference electrode, to measure noise, with the noise depending on the measured current between the two working electrodes. However, the two working electrodes must have the same characteristic behavior, or the corrosion estimate will not be accurate (the required, yet rarely accurate, assumption being that both working electrodes are corroding at the exact same rate and in the same way). The present disclosure describes a system which uses only <u>one working electrode</u>, in addition to a reference electrode, to measure corrosion noise. The third electrode is an <u>auxiliary electrode</u>, which does not participate in the electrochemical reaction or corrode like a working electrode, and is simply used to source or sink current.

The disclosed system works as follows: First, a current-varying perturbation signal is applied to the working electrode. The perturbation signal is composed of at least one known

sinewave (or other alternating waveform) component and may include a DC offset. The potential of the working electrode is made to match that of the applied perturbation signal by the potentiostat arrangement. The result is that a varying current is sensed by an ammeter connecting the working electrode and the auxiliary electrode. However, the additional noise signal now present in the sensed current is a result of the corrosion of only the single working electrode. Because of this, the problem of trying to maintain uniform characteristics of two working electrodes when measuring current noise is eliminated.

The signal which is measured by the ammeter therefore contains both a component having a frequency or frequencies matching that of the applied perturbation signal, and a component representing the current noise of the working electrode. Because the frequency of the applied perturbation signal is known, the "perturbation signal component" can be separated from the measured signal using frequency filtering. This filtered perturbation component represents the response of the system to the applied perturbation signal and can be used to calculate the impedance of the working electrode (which can in turn be used to determine the overall corrosion <u>rate</u>).

Once the corrosion rate is determined, the remaining portion of the measured signal left after separating out the applied frequencies will contain the current noise signal, which can be used to determine the <u>type</u> of corrosion (i.e., localized or uniform).

An alternate embodiment is similar to that discussed above. However, the <u>current</u> through the working electrode and auxiliary electrode is held to a predetermined sinewave, with the resulting fluctuating <u>voltage</u> between the working electrode and the reference electrode being measured by a voltage sensor. The perturbation component of the measured voltage signal is again filtered out and used (along with the known applied current signal) to determine the impedance of the working electrode, and thereby also determine the corrosion rate. The remaining potential noise signal is then used to determine the type of corrosion present in the working electrode.

Rejections under §103(a)

With the above explanation as a starting point, the specific rejections under § 103(a) will now be addressed. Claims 1 and 10 have been rejected under 35 U.S.C. §103(a) as being

unpatentable over U.S. Patent No. 6,320,395 to Bosch et al in view of U.S. Patent No. 5,425,867 to Dawson et al.

The Office Action states that column 2, line 66 to column 3, line 9 of Dawson discloses filters provided to "separate out the current noise signal and potential noise signal at a desired frequency". Applicant respectfully disagrees. The cited passage describes using a filter to "remove DC and AC components of the measured current having a frequency greater than a predetermined threshold frequency". The filtering described in Dawson *removes* unwanted components from the monitored signal, and does not separate out the monitored signal into two signals. Removing an unwanted component from a monitored signal is very common in data acquisition, and is entirely different than separating out a monitored signal into two signals which will both be analyzed, as is required by claims 1 and 10.

Separating out the monitored signals into two signals allows the simultaneous determination of a signal representing the response of the working electrode to the applied frequency, and an electrochemical noise output signal. Thus, both of the separated signals relate to the same electrode (i.e. the same portion of metal). As described within the present disclosure, this allows the estimation of both the corrosion rate and the corrosion type from the same portion of metal (the single working electrode). Neither Bosch nor Dawson, either separately or in combination, teach or suggest anything which would lead a person of ordinary skill in the art to contemplate separating a monitored signal into two signals and using both of them to derive measurements.

Bosch describes using a single measurement electrode (working electrode WE, FIG. 5) to measure only the <u>rate</u> of corrosion. There is no suggestion in Bosch that the electrochemical noise should be measured, and furthermore no teaching which would indicate to a person skilled in the art how such a measurement could be made. Dawson uses two working electrodes (1, 2) to measure only electrochemical <u>noise</u>, and does not suggest at any point that the response of an electrode to an applied frequency should be measured. A person of ordinary skill in the art would therefore not be motivated to combine the disclosures of Bosch and Dawson.

Even if a person skilled in the art were to consider combining the disclosures of Bosch and Dawson, they would not be capable of devising a method of measuring the electrochemical noise and the response of the electrode to an applied frequency. For example, the skilled person would be faced with the problem of how to modify Bosch such that it works with two working

electrodes rather than one working electrode, or modify Dawson such as it works with one working electrode rather than two working electrodes. There is no obvious way in which this could be done without changing the principle of operation of either Bosch or Dawson. *See* MPEP § 2143.01(VI) ("If the proposed modification or combination of the prior art would change the principle of operation of the prior art invention being modified, then the teachings of the references are not sufficient to render the claims *prima facie* obvious. *In re Ratti*, 270 F.2d 810, 123 USPQ 349 (CCPA 1959)).

The skilled person, upon reading Dawson would note lines 47 to 55 of column 1 and lines 9 to 14 of column 2, which provide very clear teaching that a perturbation signal should *not* be applied if it is desired to measure the electrochemical noise:

> "It is the case however that the application of the perturbation signal may itself produce impedance spectra which are a function of the perturbation signal itself, for example due to the electrode shape and cell configuration. Furthermore, at low frequencies the time taken for the measurements from which the spectra is derived <u>can lead to errors</u> in the data due to spontaneous changes which occur naturally within the system being studied." Dawson, col. 1, lines 9-55.
>
> "It an object of the present invention to obtain electrochemical impedance spectra from an electrochemical system <u>without it being necessary to apply a perturbation signal</u> to the system." Dawson, col. 2, lines 9-14.

This provides the skilled person with a powerful disincentive to consider combining Dawson with Bosch. An inventive imagination would be required in order for the skilled person to go directly against the teaching of Dawson and consider measuring electrochemical noise in the presence of a perturbation signal.

Bosch teaches that two sinusoidal signals 100, 105 should be combined to create an intermodulation perturbation signal 110 (lines 33 to 35 of column 4), which is applied to the sample under measurement. If an attempt were made to measure electrochemical noise using a system based on the teaching of Bosch, it would fail. This is because the two sinusoidal signals would mix and generate a very large number of frequencies, and this large number of frequencies would mask the electrochemical noise. Bosch provides the skilled person with no guidance in relation to how to reduce this masking effect. The Office Action states that "Bosch discloses perturbating signal contains sinewaves that have a period that has an integral multiple relationship to a frequency at which the electrochemical signal is sampled." Applicant respectfully disagrees. Bosch makes no mention of the process of sampling the measured

voltages over a period that is an integral of the perturbation signal cycle; the integral multiple relationship referred to in Bosch is merely the relationship between the frequencies of the two applied signals.

For the reasons outlined above, a person of ordinary skill in the art would not be capable of devising the invention claimed in claims 1 and 10 based upon the combined disclosures of Bosch and Dawson. Applicant therefore respectfully submits that claims 1 and 10 are allowable over the references of record and request reconsideration of the rejections.

Claims 2-9 depend from claim 1 and therefore contain all of the limitations of claim 1. It is therefore respectfully submitted that claims 2-9 are allowable over the references of record for at least the same reasons set forth with respect to claim 1.

Rejections under §112

Claim 6 has been rejected under 35 U.S.C. §112 as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Specifically, the Office Action states that "it is unclear how one would filter the monitored potential to obtain an electrochemical current noise." Claim 6 has therefore been amended to refer to potential noise rather than current noise, as suggested by the Examiner.

Claim 10 has been rejected as an improper use of a "product for a process" claim. Claim 10 has therefore been rewritten in independent form as suggested by the Examiner to obviate this rejection.

Conclusion

It should be understood that the above remarks are not intended to provide an exhaustive basis for patentability or concede the basis for the rejections in the Office Action, but are simply provided to overcome the rejections made in the Office Action in the most expedient fashion. In view of the above amendments and remarks, it is respectfully submitted that the present application is in condition for allowance and an early notice of allowance is earnestly solicited.

If after reviewing this amendment the Examiner feels that any issues remain which must be resolved before the application can be passed to issue, the Examiner is invited to contact the undersigned representative by telephone to resolve such issues.

Respectfully submitted,

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